
# Animals to the Rescue—Arthritis, Menisci

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Featured

Lisa A. Fortier
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by Jackie Swift

For thousands of years the horse has been one of humanity's indispensible and most honored animal companions. By harnessing their strength and speed, we have roamed the earth, tilled the ground and built great cities. Now, if Lisa A. Fortier, Veterinary Medicine, has her way, the horse may help us once again—this time to conquer arthritis.

Fortier is studying post-traumatic arthritis in horses, especially after injuries to the ankle joint. Horses are natural athletes, and just like human athletes, they put great strain on their legs and joints. Ankle injuries are common and lead to arthritis in the joint. "In humans and in horses, we know that if you sprain your ankle, it will lead to arthritis," Fortier says. "If it's a severe sprain, it will lead to arthritis in a couple of years. If it's a mild sprain, it could be decades before the arthritis appears."

## How Studying Arthritis in Horses Helps the Human Disorder

The ankle joint of a horse is close in size to the human ankle joint, and by studying the affects of trauma on horse ankles Fortier hopes to discover new treatments for humans as well. To that end, Fortier and her lab have joined with a team of researchers—PhD Candidate Michelle Delco; Hazel H. Szeto, Weill Cornell Medicine; Lawrence J. Bonassar, Warren R. Zipfel, and Rebecca M. Williams, Biomedical Engineering; Itai Cohen, Physics; and John G. Kennedy, Hospital for Special Surgery in New York City. "The breadth of our collaboration has lead to research that just isn't possible at other veterinary schools," Fortier says.

Fortier started out looking at early cartilage damage in horses. The traditional way to study cartilage in a live animal is to take it out of the joint and look at it under a microscope. "That cartilage doesn't grow back, so we don't like to do that because we know we're causing injury by removing it," Fortier says. "Our colleagues in Biomedical Engineering made us a special microscope that we can insert into the joint of a live animal. With that, we are better able to characterize the amount of trauma and to see what is happening in live cartilage at the cellular level. We can study the mitochondria inside the cells as they reside in the joint."

## A Pharmaceutical that Could Quickly Stabilize Early Arthritis after Trauma

Mitochondria are the powerhouse of the cell. Stabilizing or restoring their function is key to treating traumatic joint injuries and preventing arthritis, Fortier says. One way to do that is through the actions of special peptides. Pharmacologist Hazel Szeto, M.D., Ph.D., a member of the project team, has developed a type of peptide, called an SS Peptide, to target the inner membrane of mitochondria and stabilize them. "Where there is early arthritis after a trauma, we've shown that these peptides can positively affect mitochondrial function and prevent or reverse joint damage," Fortier says.

The SS Peptides are also easily administered. A few drops under the tongue or in the eye, and the peptides are absorbed into the body where they quickly speed to all the cells. "You could take these drops right at the time of injury," Fortier says. "You wouldn't have to wait two weeks to see your doctor and have the disease process developing all that time. You could stop it right when it first happens."

Clinical approval for human testing of the SS Peptides for arthritis may come soon, but in the meantime, Fortier is working out exactly what dosage is required in horses to get the peptides to the affected joint. And she is continuing to meet weekly with a special "cartilage group" made up of cross-disciplinary researchers and their amazing graduate students. "You have engineers, veterinarians and physicists looking at the exact same tissue," Fortier says. "As a group, we can look at things the way no one else can because we approach it from completely different angles."

## The Perfect Custom-Made Knee Meniscus

Fortier's enthusiasm for collaboration is evident in another of her projects involving artificial knee menisci. The meniscus is tissue comprised of cartilage that provides structural integrity for the knee. In humans, injury to the meniscus is fairly common, especially among teenage girls and young women who play sports. Their tendency to meniscus injury may stem from a lack of hip strength, which puts pressure on other mechanics of the leg, although more research is needed in this area, Fortier says. For now, her collaboration with Jeremy Mao of Columbia University Medical Center and knee surgeon Scott Rodeo of the Hospital for Special Surgery may provide relief for those who suffer this type of injury. In the future, they may receive new menisci using a three-dimensional printing process developed by Mao.

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"Until now, if you needed a new meniscus you had to get it from a cadaver," Fortier says. "They're not readily available, and it could be a terrible mismatch in size and shape. But using Jeremy's three-dimensional process, we can now take an MRI of your knee and then print a full meniscus, or any part of it we want, and you will have your own custom-made meniscus that fits perfectly. We are testing these menisci in sheep now because sheep knees closely resemble human ones."

The three-dimensional printed scaffolding is made of an absorbable material implanted with specially distributed growth factors, two human proteins that draw stem cells from neighboring tissue. The scaffold is surgically implanted in the knee. The result is the development of a new meniscus that is an exact replication of the original one. "We don't

have to implant stem cells because the growth factors draw from the body's own local stem cells," Fortier says.

A year into the study, the results have been very positive. In the coming month, another group of sheep will be sent to the Hospital for Special Surgery for MRIs to check on the progress of their new knees. Then Fortier anticipates more analysis followed by further refinement as the researchers await approval to test the procedure in humans.

"With these projects, we have the opportunity to develop technology that can help people and animals; the benefits are cross-species," Fortier says with satisfaction. "But it's more than that. The collaboration is cross-department, cross-college and cross-campus. That's what propels us forward. It's very exciting."



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